REMARKS

Entry of the foregoing and continued examination of the subject application is respectfully requested in light of the amendments above and the comments which follow.

As correctly noted in the Office Action Summary, claims 4-20 were pending. By the present response, claims 4 and 9-12 have been amended and claims 5 and 7-8 canceled. Thus, upon entry of the present response, claims 4, 6 and 9-20 remain pending and await further consideration on the merits.

Support for the foregoing amendments can be found, for example, in at least the following locations in the original disclosure: the original claims and the specification, paragraph [0024].

CLAIM REJECTIONS UNDER 35 U.S.C. §112

Claims 5 and 8 have been rejected under 35 U.S.C. § 112, second paragraph, on the grounds set forth in paragraph 3 of the Official Action. By the present response, Applicants have canceled these claims. Withdrawal of the rejection is respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. §103

Claims 4, 9-13, and 15-20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,507,551 to Howard et al. (hereafter "*Howard et al.*") in view of Applicant's Admitted Prior Art, U.S. Patent No. 5,369,511 to Amos (hereafter "*Amos*") and U.S. Patent Application Publication No. 2001/0029816 to Ben-Menachem et al. (hereafter "*Ben-Menachem et al.*") on the grounds set forth in

paragraph 6 of the Official Action. For at least the reasons noted below, this rejection should be withdrawn.

The present application relates generally to infrared imaging systems. Exemplary embodiments of the disclosed infrared imaging system are illustrated in Figures 1 and 2. The infrared imaging system 100 has a compressor housing 102 and an optical housing 104. The optical housing 104 has a cryogenic subassembly 106, an optical subassembly 108 and an electronics subassembly 110. The optical subassembly 108 is positioned within the cold space 116 of the cryogenic subassembly 106 at the receiving end 118 of the optical housing 104.

As shown in Figure 2, a detector 208 is positioned in alignment with the other components of the optical subassembly 200 about the axis X-X' at a focal length distance d from the second surface 216 of the lens 206, at a coincident focal plane to at least two wavelengths manipulated and transmitted by the first lens 206, e.g., by aspheric and HOE elements on surfaces of the first lens. The two wavelengths are a first color band of infrared energy having wavelengths of 3 to 5 μm and a second color band of infrared energy having wavelengths of 8 to 12 μm. The detector 208 can discriminate at least two or more wavelengths of incident energy in the IR spectrum, such as wavelengths at 3-5 μm and 8-12 μm. The detector 208 processes the wavelengths to produce multiple waveband detection capability within a single detector, e.g., a multispectral detector. In an exemplary embodiment, the detector 208 concurrently collects radiation from multiple, adjacent spectral radiation bands. This type of detector may be used in "multispectral imaging" or "hyperspectral imaging."

Several advantages of the exemplary infrared imaging system 100 are disclosed at paragraphs [0035] to [0037]. For example, use of a single, color correcting element in the dewar provides an optical subassembly that is shorter and provides for a better form factor and lower part count for the entire infrared imaging system. Also, by enclosing the single lens within the detector dewar, the optical subassembly, including the optical stop, lens and detector, are all located within a single enclosure. Previously, tight alignment tolerances had to be maintained across the detector-to-dewar mount, the dewar-to-optical housing mount and the optical housing-to-optics mount. By eliminating the multiple interfaces the total tolerance budget can be applied on the single interface, reducing the required manufacturing and assembly tolerances and reducing the requirement for precision alignment across multiple interfaces.

In another example, placing the single, color correcting first lens 206 in the cryogenic subassembly 106 is advantageous because it places the optical subassembly 200 in a controlled temperature environment. By maintaining the lens 206 at a nearly constant temperature, the need for a passive or active athermalization system to correct the thermally induced focus variations may be eliminated. While this could be accomplished previously by heating or cooling the optics with a separate device, this approach makes use of the cooling capabilities that are already present in the system. Also, enclosing the optical subassembly 200 in the cryogenic subassembly 106 places the optics in a sealed, evacuated environment, protecting it against dust or other contamination. While this could be accomplished in a separate enclosure, this approach makes use of capabilities already present in the optical housing 104.

In addition, the alignment of the optical components permits a detector to be located at the focal plane for the lens system. In previous multi-lens imaging systems, it was difficult to ensure alignment of the optical components because the thermal coefficient of expansion resulted in disparate movement of the individual optical components. A unitary structure housed within the cold space essentially eliminates thermal transients amongst the components once a temperature equilibrium has been achieved by the cryogenic housing and compressor, thereby overcoming the alignment problems.

The foregoing features also permit the design of a lower cost system with the same performance capabilities of current, more expensive ones.

The above features are broadly encompassed by Applicants' claims. Claim 4, the only independent claim at issue here, recites that an infrared imaging apparatus, comprises, *inter alia*, a dewar, an IR transmissive window that seals the cold space to receive IR energy directly from an IR source, a first lens located within the cold space to receive IR energy directly from the IR transmissive window, an IR detector located within the cold space in operational communication with the first lens and positioned coincident to the focal plane of at least a first and second wavelength of IR energy, and an optical stop located within the cold space in front of the first lens. The first lens has a first aspheric profile on a first side and a second aspheric profile on a second side, the first side parallel to the second side and the second side facing the detector. The second aspheric profile has a holographic optical element. The holographic optical element color corrects both a first color band of infrared energy having wavelengths of 3 to 5 microns and a second color band of infrared energy having wavelengths of 8 to 12 microns.

Applicants claim distinguish over the proposed combination in *Howard et al.*, Applicant's alleged Admitted Prior Art, *Amos* and *Ben-Menachem et al.* for at least the following reasons.

The present claims of the application include an infrared imaging apparatus that corrects multiple wavebands at the same time using a first lens, e.g, a single lens. While it is true that a holographic element can correct the aberrations at any point along the electro-magnetic spectrum (often called the center wavelength for the holographic element), a single holographic element as disclosed in the cited documents cannot correct the aberrations at two points along the electro-magnetic spectrum as presently claimed. For example, it is known that a single holographic element can correct aberrations for a center wavelength. Also, wavelengths within about 1 μm of the centerline (for IR wavelengths, about 0.5 μm for visible wavelengths) may be correctable, although with decreasing efficiency as the wavelength is further seperated from the centerline wavelength.

The presently claimed infrared imaging apparatus is quite different from the cited and know prior art. For example, the claimed first lens corrects design aberrations, e.g., "wavefront error", corrects field curvature correction, and color corrects highly separated wavelengths of IR energy, e.g., 3-5 μm and 8-12 μm, with a single lens

In other words, the claimed first lens has two centerline wavelengths. the claimed infrared imaging apparatus essentially allows one to place two holographic elements, correcting two different parts of the electro-magnetic spectrum on the same physical lens surface. This solution is not disclosed, taught or suggested in the proposed combination in the Official Action. The cited prior art has only one

centerline wavelength. Accordingly, the disclosed structures in *Howard et al.*, Applicant's alleged Admitted Prior Art, *Amos* and *Ben-Menachem et al.*, both alone or in combination, simply do not perform and cannot perform to provide the claimed features. Each of the cited documents and sources only disclose, at best, systems with a single centerline wavelength.

With respect to the Examiner's position on the disclosure in *Amos*, it is acknowledged that *Amos* states that you can use a holographic element to correct the aberrations of "all wavelength". While it is true that a holographic element can correct the aberrations at any point along the electro-magnetic spectrum, it is also true that you cannot correct the aberration of all points on the electro-magnetic spectrum at the same time with the same hologram. It is respectfully asserted that a correct interpretation of this disclosure is that one can shoes a holographic element to correct any single centerline wavelength from amongst all the wavelengths. This reference, however, does not support an interpretation that a single holographic element can correct all wavelengths at the same time with a single element.

As previously stated, a conventional holographic element has only a limited wavelength range over which it can correct aberrations. Holographic elements are typically centered around a single design wavelength. Here, the claimed infrared imaging apparatus uses of a single physical lens with two design wavelengths. In other words, the claimed infrared imaging apparatus essentially allows one to place two holographic elements, correcting two different parts of the electro-magnetic spectrum, on the same physical lens surface. This solution is not disclosed, taught or suggested in the proposed combination in the Official Action.

With respect to the alleged admitted prior art, while Applicants do note that computer software can assist in modeling a standard aspheric surface as presented in Equation 1, there is no admission at paragraph [0027] or elsewhere to the claimed combination of first aspheric profile, second aspheric profile, holographic element and first lens as claimed. Indeed, there has been no showing in the Official Action of these features and capabilities combined on a single lens as claimed.

With respect to the disclosure in *Ben-Menachem et al.*, it has been previously noted that this document merely discloses aspheric surfaces with or without diffractive patterns for correcting aberrations in the optical system. *Ben-Menachem et al.* does not disclose, teach or suggest color correcting both a first color band of infrared energy and a second color band of infrared energy with the same first lens, nor does it disclose, teach or suggest performing such operations by using a first lens with the optical features as claimed.

With respect to the disclosure in *Howard et al.*, the optical elements in this document cannot resolve sufficiently separated spectral bands, such as those claimed, e.g., bands with wavelengths of 3-5 μm and 8-12 μm, without creating chromatic aberrations. The solution in *Howard et al.* is the placement of a separate Schmidt plate at or near the aperture stop (column 2, lines 21-25) to correct the spherical aberration of the imaging lens. There is simply no disclosure in *Howard et al.* to a first lens having the claimed combination of features.

Taken together, the disclosures in *Howard et al.*, Applicant's alleged Admitted Prior Art, *Amos* and *Ben-Menachem et al.* do not disclose, teach or suggest Applicants' independent claim 4. Accordingly, the rejection should be withdrawn.

The remaining claims depend either directly or indirectly from claim 4 and are therefore distinguishable over the cited documents for at least the same reason as discussed with respect to claim 4. Withdrawal of these rejections is respectfully requested.

Claims 6, 7, and 14 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Howard et al.*, in view of Applicant's Admitted Prior Art, *Amos* and *Ben-Menachem et al.* as applied to claim 4 above, and further in view of U.S. Patent No. 6,034,407 to Tennant et al. (hereafter "*Tennant et al.*") on the grounds set forth in paragraph 7 of the Official Action. For at least the reasons noted below, this rejection should be withdrawn.

First, claim 7 has been canceled, obviating the rejection.

Claims 6 and 14 depend directly from claim 4. Because *Tennant et al.* fails to overcome the deficiencies of the documents discussed above, these claims are distinguishable for at least the same reason as discussed with respect to claim 4.

CONCLUSION

From the foregoing, further and favorable action in the form of a Notice of Allowance is earnestly solicited. Should the Examiner feel that any issues remain, it is requested that the undersigned be contacted so that any such issues may be adequately addressed and prosecution of the instant application expedited.

Respectfully submitted,

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